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ALLELOPATHIC EFFECTS OF VARIOUS TREE LEAVES EXTRACTS ON GERMINATION AND SEEDLING GROWTH OF *CYPERUS ROTUNDUS (L.), TRIANTHEMA PORTULACASTRUM (L)* AND *DACTYLOCTENIUM AEGYPTIUM (L)*

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ABSTRACT

A study on the allelopathic effect of leaf extracts of Prosopis juliflora, Tamarindus indica, Eucalyptus camaldulensis, Annona squamosa and Mangifera indica at 10, 20 and 30 percent concentrations on germination and seedling growth of Cyperus rotundus, Trianthema portulacastrum and Dactyloctenium aegyptium was conducted at Agricultural College and Research Institute, Madurai during 2015. The results of this study revealed that allelopathic chemicals in leaf extracts of mango leaves drastically suppressed the germination of Cyperus rotundus (48.3%), Trianthema portulacastrum (50.7%) and Dactyloctenium aegyptium (51.1%). Pre-emergence application of Mangifera indica leaf extract at 30 per cent distinctly reduced the fresh weight and dry weight of Cyperus rotundus, Trianthema portulacastrum and Dactyloctenium aegyptium. The higher Cyperus, Trianthema and Dactyloctenium control efficiency (73.7, 63.4% and 43.0%, respectively) were registered under the treatment of pre-emergence application of Mangifera indica leaf extract at 30 per cent. The findings from our study suggests that compounds from mango leaves extract have a strong phytotoxic impending and can provide as lead molecules for the production of bioherbicides.

KEYWORDS: Allelopathic Chemicals, Leaf Extracts, Germination & Control Efficiency

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Original Article

INTRODUCTION

Weeds are defined as unwanted plants growing in agricultural lands, gardens, roadsides and mainly disturbed areas, where, they do not depend on human intervention for their reproduction and survival (Lewu and Afolayan, 2009). *Cyperus rotundus* is the world's worst weed. It has the ability to survive under adverse conditions and grow explosively with limited sources. The principal method of propagation of this weed is through the basal bulbs and tubers. Great yield losses occurred when compete with crops. *Trianthema portulacastrum* has been reported in all the states of India, especially, Uttar Pradesh, Punjab, Haryana, Rajasthan and Delhi under garden land condition, and considered as a number one problematic terrestrial weed by virtue of its infestation in various agricultural and vegetable crops such as mustard, red gram, green gram, potato, onion, cotton, soybean, pearl millet and sugar cane, particularly during the rainy seasons (Aneja *et al.*, 2000). During the 20th century, prominent concentration was paid to the use of herbicide to control the growth of weeds, which compete with crops for light

space and nutrients against agricultural crops. Various herbicides were used for weed control. Allelopathy is a natural and environmentally friendly technique, which may prove to be a tool for weed management and thereby increase the crop yields. So, the term allopathy is commonly denoted the interaction in which one plant could cause suffering to another plant (Rice, 1984). Hence, the plant is a vast source of naturally occurring and selective herbicide. Allelopathic effect may be environmentally friendly since it could be extracted from flower, leaves, stem and roots. These allelopathic extracts could be used to control the growth of weeds (Chon *et al.*, 2003). The main principle in allelopathy arises from the fact that plants produce thousands of chemicals and many of these chemicals are released by leaching, exudation or decomposition processes. Subsequently, some of these compounds which are known as allelochemicals alter the growth or physiological functions of receiving species. The most commonly found allelochemicals are economy, benzoic acids, flavonoids and various terpenes (Singh *et al.*, 2003); these compounds are known to be phytotoxic (Einhellig, 2002). Aqueous extracts of an old mango leaves reduced the germination, shoot length, root length and dry weight by 95, 96, 93 and 95 %, respectively (Kamran *et al.*, 2013). Keeping this in view, the present investigation was carried out to find out the allelopathic effect of different tree leaf extracts on germination and seedling growth of three weed species.

MATERIALS AND METHODS

The pot culture experiment was conducted at Agricultural College and Research Institute, Madurai during 2015, in completely randomized block design with three replications. Seeds of *Trianthema portulacastrum*, *Dactyloctenium aegyptium* and tubers of *Cyperus rotundus* were collected nearby locality and dried in a shade for about a week. Air dried seeds or tubers with moisture content below 12% were used for this experiment. Leaves of *Prosopis juliflora*, *Tamarindus indica*, *Eucalyptus camaldulensis*, *Annona squamosa* and *Mangifera indica* species at vegetative stage were collected and leaves were washed gently with tap water seconds for removing contaminants like dust, etc. The fresh leaves of above species cut into smaller spaces, soaked in alcohol and water @ 1:1 proportion and kept in overnight. After 12 hours, soaked leaves were macerated with the help of mixer grinder. From the past, the leaf extract of each botanical species was prepared by filtration, which represented 100 percent stock solution. From the stock solution, 10, 20 and 30 percent concentration were prepared and sprayed as per the treatment schedule. Five different weed species were sown in pots, which filled with soil. Ten seeds/tubers were sown in each pot. The freshly prepared extracts of 10, 20 and 30 per cent were sprayed on the soil surface before the emergence of weed seeds and control pot was maintained by spraying with water. Germination of weed species was counted on 10 DAS. Fresh weight of seedlings were weighed 30 days (DAS) after sowing and expressed in grams. Dry weight of seedling was recorded after drying in hot air oven maintained at 65°C for 24 hours on 30 DAS. The dried seedlings were weighed, averaged and expressed in grams. The weed control efficiency (WCE) was calculated based on the dry weight of weed seedling.

$$WCE\ (\%) = \frac{WDC - WDT}{WDC} \times 100$$

Where, WDC = Weed seedling dry weight in control pot, WDT = Weed seedling dry weight in treated pot

RESULTS AND DISCUSSIONS

Germination is the resumption of metabolic activities and growth of the seed tissue and initial step in germination is absorbing water, which takes place through imbibitions and osmosis which causes activation of enzymes and increased in metabolic activities. The data revealed that the application of different tree leaf extracts caused considerable suppression of *Cyperus rotundus*, *Trianthema portulacastrum* and *Dactyloctenium aegyptium* germination when compared to control (Table 1 and 2). Among the leaf extracts, the maximum inhibition of *Cyperus rotundus* (48.3%), *Trianthema portulacastrum* (50.7%) and *Dactyloctenium aegyptium* (51.1%) were observed with pre-emergence application of *Mangifera indica* leaf extract at 30 per cent. The maximum germination per cent of *Cyperus rotundus* (91.0%) and *Trianthema portulacastrum* (92.4%) and *Dactyloctenium aegyptium* (90.8%) were noticed under control. The inhibitory effect in different concentration of leaf extracts on seed/tuber germination might be due to an imbalance in metabolism regulated by various enzyme activities (Oyun, 2006). Further reduction in germination per cent might be also due to herbicidal activity of flavonoids, compounds (Javaid *et al.*, 2010).

All the leaf extracts exhibited significant inhibitory activities in growth parameters of all the three weed species. Fresh weight of foliage (0.38 g), fresh weight of tuber (1.00 g), total fresh weight (1.38 g), dry weight of foliage (0.23 g), dry weight of tuber (0.49 g) and total dry weight (0.72 g) of *Cyperus rotundus* were significantly reduced with pre-emergence application of *Mangifera indica* leaf extract at 30 per cent. The minimum value of *Cyperus rotundus* growth parameters was observed with control. Fresh weight (1.27 and 0.89 g) and dry weight (0.63 and 0.45 g) of *Trianthema portulacastrum* and *Dactyloctenium aegyptium* considerably decreased with pre-emergence application of *Mangifera indica* leaf extract at 30 per cent when compared to other treatments. The lower fresh weight (3.47 and 1.83 g) and dry weight (1.72 and 0.79 g) of *Trianthema portulacastrum* and *Dactyloctenium aegyptium* were recorded under control. The reduction in fresh and dry weight might be attributed to the reduced rate of cell division and cell elongation due to the presence of allelochemicals present in the leaf extracts (Buckolova, 1971). This might be also due to the presence of allelochemical mangiferin in the mango leaves (Nong *et al.*, 2005). Allelochemicals reduce water and nutrient uptake by roots and inhibit photosynthesis, respiration, protein synthesis, cell division and thickness of seminal roots as well as cause slow maturation and delay or failure of reproduction (Jafariehyazdi and Javidfar, 2011). It is precious to disclose that dried mango leaf powder and mango leaf extract inhibits germination and seedling growth of *Cyperus rotundus* (El-Rokiek *et al.*, 2010). Among the leaf extracts spray, the higher weed control efficiency of *Cyperus*, *Trianthema* and *Dactyloctenium* control efficiency (73.7, 63.4% and 43.0%, correspondingly) were registered under the treatment of pre-emergence application of *Mangifera indica* leaf extract at 30 per cent. This could be due to active inhibition of germination and reduction in seedling growth resulted in higher *Cyperus*, *Trianthema* and *Dactyloctenium* control efficiency as compared to control.

CONCLUSIONS

From the study, it clearly indicates that the mango leaf extract might be used as protective tool to smother the growth of *Cyperus*, *Trianthema* and *Dactyloctenium.* Moreover, mango leaves have a strong phytotoxic impending, and can serve as lead molecules for the production of bioherbicides. Further research is needed to identify the allelochemicals, which are responsible for weed germination and growth reduction.

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APPENDICES

Table 1: Effect of different Tree Leaf Extracts Spray on Germination (%), Fresh Weight (G Seedling^{-1}), Dry Weight (G Seedling^{-1}) and Control Efficiency (%) of Trianthema Portulacastrum (L.) and Dactyloctenium Aegyptium (L)

Treatment	Trianthema Portulacastrum (L.)				Dactyloctenium Aegyptium (L.)			
	Germination	Fresh Weight	Dry Weight	*Trianthema* Control Efficiency	Germination	Fresh Weight	Dry Weight	*Dactyloctenium* Control Efficiency
T_1 - PE *Prosopis juliflora* leaf extract @ 10%	58.9	2.74	1.35	21.5	64.2	1.45	0.68	13.9
T_2 - PE *Prosopis juliflora* leaf extract @ 20%	53.8	1.96	0.92	46.5	59.3	1.14	0.55	30.4
T_3 - PE *Prosopis juliflora* leaf extract @ 30%	52.6	1.82	0.89	48.3	57.5	1.13	0.52	34.2
T_4 - PE *Tamarindus indica* leaf extract @ 10%	66.2	3.25	1.51	12.2	68.5	1.73	0.76	3.8
T_5 - PE *Tamarindus indica* leaf extract @ 20%	59.1	2.84	1.41	18.0	64.6	1.49	0.72	8.9
T_6 - PE *Tamarindus indica* leaf extract @ 30%	57.6	2.68	1.26	26.7	60.6	1.31	0.64	19.0
T_7 - PE *Eucalyptus camaldulensis* leaf extract @ 10%	63.7	3.15	1.44	16.3	67.4	1.64	0.75	5.1
T_8 - PE *Eucalyptus camaldulensis* leaf extract @ 20%	58.1	2.70	1.31	23.8	60.6	1.41	0.67	15.2
T_9 - PE *Eucalyptus camaldulensis* leaf extract @ 30%	54.7	2.22	0.98	43.0	59.5	1.19	0.58	26.6
T_{10} - PE *Annona squamosa* leaf extract @10%	56.5	2.50	1.15	33.1	59.9	1.29	0.61	22.8
T_{11} - PE *Annona squamosa* leaf extract @ 20%	52.0	1.75	0.85	50.6	56.5	1.01	0.51	35.4
T_{12} - PE *Annona squamosa* leaf extract @ 30%	51.3	1.63	0.76	55.8	52.8	0.96	0.46	41.8
T_{13} - PE *Mangifera indica* leaf extract @ 10%	55.0	2.45	1.06	38.4	59.8	1.20	0.60	24.1
T_{14} - PE *Mangifera indica* leaf extract @ 20%	51.7	1.68	0.80	53.5	53.7	1.00	0.49	38.0
T_{15} - PE *Mangifera indica* leaf extract @ 30%	50.7	1.27	0.63	63.4	51.1	0.89	0.45	43.0
T_{16} - Control (No spray)	92.4	3.47	1.72	-	90.8	1.83	0.79	-
CD (p=0.01)	**2.53**	**0.10**	**0.05**	-	**2.70**	**0.05**	**0.03**	-

*The data subjected to *Trianthema* and *Dactyloctenium* control efficiency were not statistically analyzed

Table 2*:* Effect of Different Tree Leaf Extracts Spray on Germination *(%),* Fresh Weight *(G* Seedling^{-1}*),* Dry Weight *(G* Seedling^{-1}*)* and Control Efficiency *(%)* of Cyperus Rotundus *(L)*

Treatment	Cyperus Rotundus (L.)							
	Germination	Fresh Weight of Foliage	Fresh Weight of Tuber	Total Fresh Weight	Dry Weight of Foliage	Dry Weight of Tuber	Total dry Weight	Cyperus Control Efficiency
T_1 - PE *Prosopis juliflora* leaf extract @ 10%	57.6	1.04	2.40	3.44	0.61	1.31	1.92	29.9
T_2 - PE *Prosopis juliflora* leaf extract @ 20%	53.1	0.83	1.55	2.38	0.40	0.83	1.23	55.1
T_3 - PE *Prosopis juliflora* leaf extract @ 30%	52.5	0.71	1.32	2.03	0.39	0.71	1.10	59.9
T_4 - PE *Tamarindus indica* leaf extract @ 10%	63.3	1.32	2.76	4.08	0.91	1.42	2.33	15.0
T_5 - PE *Tamarindus indica* leaf extract @ 20%	58.7	1.11	2.48	3.59	0.76	1.36	2.12	22.6
T_6 - PE *Tamarindus indica* leaf extract @ 30%	56.7	0.96	2.19	3.15	0.53	1.17	1.70	38.0
T_7 - PE *Eucalyptus camaldulensis* leaf extract @ 10%	61.2	1.15	2.65	3.80	0.83	1.39	2.22	19.0
T_8 - PE *Eucalyptus camaldulensis* leaf extract @ 20%	57.2	0.98	2.37	3.35	0.55	1.25	1.80	34.3
T_9 - PE *Eucalyptus camaldulensis* leaf extract @ 30%	53.3	0.84	1.78	2.62	0.43	0.96	1.39	49.3
T_{10} - PE *Annona squamosa* leaf extract @10%	55.0	0.92	2.08	3.00	0.52	1.10	1.62	40.9
T_{11} - PE *Annona squamosa* leaf extract @ 20%	51.7	0.64	1.16	1.80	0.38	0.58	0.96	65.0
T_{12} - PE *Annona squamosa* leaf extract @ 30%	50.1	0.46	1.05	1.51	0.28	0.53	0.81	70.4
T_{13} - PE *Mangifera indica* leaf extract @ 10%	53.3	0.87	1.96	2.83	0.46	1.08	1.54	43.8
T_{14} - PE *Mangifera indica* leaf extract @ 20%	51.0	0.59	1.08	1.67	0.36	0.53	0.89	67.5
T_{15} - PE *Mangifera indica* leaf extract @ 30%	48.3	0.38	1.00	1.38	0.23	0.49	0.72	73.7
T_{16} - Control (No spray)	91.0	1.67	2.81	4.48	1.21	1.53	2.74	-
CD(p=0.01)	**2.49**	**0.04**	**0.08**	**0.11**	**0.03**	**0.04**	**0.07**	-

*The data subjected to *Cyperus* control efficiency was not statistically analyzed